

Exploring Maps — Information

What else is here?

Maps are made for many reasons, and as a result, maps are of many kinds. Some made for general purposes may show roads, towns and cities, rivers and lakes, parks, and State and local boundaries. One example of such a versatile map, or **base map**, is the 1938 topographic map which portrays natural and man-made features of an area. Other maps are much more specific, conveying information primarily on a single topic. A map that depicts earthquake occurrences throughout the United States is a good example of a special-purpose map, or **thematic map**. Every map is made for a purpose and serves that purpose best.

The history of civilization has been illustrated by maps—battle maps by soldiers, exploration maps by empire builders, thematic maps by scientists. By modern convention, and for no scientific reason, modern maps are usually oriented with north at the top. But Al Idrisi's 1154 world map shows the Arabian Peninsula in the top center of the map, with south at the top. Contrast this map with the 1452 Leardo world map. Different societies in different places literally have different perspectives, which may result from differences in physical geography, language, religion, cultural values and traditions, and history.

Even within a culture, a time, and a geographic realm, maps can vary widely. This is because a map shows the cartographer's bias as well as the

purpose. Maps are the result of conscious design decisions. Cartographers decide how to generalize and symbolize what they are trying to show. They select features (or themes) to show and omit other features. They often generalize the data, simplifying the information so that the map is easier to read.

In choosing the scale, mapmakers determine how large an area they can map and how much detail they can show. The selection of symbols (which can include lines, patterns, and colors) also affects the legibility, aesthetics, and utility of the map.

Cartography blends science and art. A beautiful map may become popular, even though it may be less accurate than a plainer version. Details of cartographic style affect how a map is perceived, and perception varies with perspective. In short, people understand the world differently, have different modes of expressing this understanding in maps, and gain different understanding from maps.

Geographic features can be shown at different sizes and levels of detail by using **scale**. Maps include selected basic geographic information to provide **context**. Every map has a purpose or theme. The **map design**, which includes artistic aspects such as composition and balance, affects the success of the map—that is, its ability to communicate.

Scale is the relationship between the size of a feature on the map and its

actual size on the ground. Scale can be indicated three ways. The **bar scale** is a line or bar that has tick marks for units of distance. The bar scale is especially important because it remains accurate when a map is enlarged or reduced. A **verbal scale** explains scale in words: "one inch represents 2,000 feet." The **representative fraction** is a ratio such as 1:24,000, in which the numerator (1) represents units on the map and the denominator (24,000) represents units on the ground; in the example of 1:24,000 scale, one unit (any unit—feet, millimeters, miles, etc.) on the map represents 24,000 of the same units on the ground.

Scale controls the amount of detail and the extent of area that can be shown. Scales can be described in relative terms as large scale, intermediate scale, and small scale. A **large scale** map (for example, the 1886 Sanborn map, originally at 1:600 scale) shows detail of a small area; a **small scale** map (for example, the 1877 geologic map of north-central Colorado, originally at 1:253,440 scale) shows less detail, but a larger area. (A comparison of representative fractions shows that 1/600 is larger than 1/253,440.)

The humorous 1893 quotation from Lewis Carroll (on Poster Side 2) illustrates this point by taking scale to the extreme. Some small scale maps are regional **compilations** of more detailed maps, bringing information together for the first time at a common scale.

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Context is information that serves to orient the map reader to the mapped place. As you look at the maps in the Poster Side 1, you may look for familiar features (such as the “boot” of Italy) to identify the area shown. Geographic information that provides context can include coastlines, boundaries, roads, rivers and lakes, cities and towns, topographic features, place names, and latitude and longitude.

Distortion is another important aspect of context; every flat map of a curved surface is distorted. The choice of map projection determines how, where, and how much a map is distorted. It is important to understand the kind and amount of distortion on the map sheet. The typical mapping project now plots information on a base map, which shows where the place is and establishes the scale, orientation, context, and spatial distortion of the information to be mapped. The type and scale of the mapping project affect the choice of base map. Digital, or computerized, mapping frees the cartographer from some constraints imposed by a base map, because features can be readily selected or deleted, and the projection and scale can be changed easily.

A map’s purpose is usually clear from its title and explanation, but other information (author, date, publisher, source of funding, etc.) hints at why and for whom the map was made. A knowledgeable map reader, recognizing that a map is both a simplification and a distortion

of reality, will look for clues to the cartographer’s purposes and biases.

The information collected for a mapping project is called **spatial data**. Any object or characteristic that can be assigned a geographic location can be considered spatial data. Spatial data always include location, but many also include values to be represented.

These two kinds of information are **qualitative data** (for example, schools, roads, rivers, States) and **quantitative data** (for example, altitudes, amount of precipitation, per capita income, population density). Qualitative data, while not numeric values, may be ranked, as in categories of roads or schools.

Quantitative data can be treated in many ways. The cartographer may first decide to **generalize** data. Several closely spaced points may be generalized to one symbol; features may be eliminated as map scale is reduced; questionable data may be eliminated where other data are sufficient.

Likewise, **grouping** of data can be done in different ways. Large ranges of numbers may be grouped with breaks at round numbers (for example, 10, 20, 30) or at statistical mean and standard deviation values; in this case, the individual points may be mapped in various colors or sizes to correspond with group values. Another way to group data is within geographic areas, using colors or symbols for areas, rather than symbols at each data location.

Generalization and grouping dramatically affect the message the map presents by simplifying the data.

The success of a thematic map depends on **map design**. Scientific maps like Edmund Halley’s 1701 map of compass variations usually show only enough geographic data to orient the user, while emphasizing the content. Halley, for whom the comet is named, pioneered several cartographic techniques. The 1701 map introduced **isolines**, lines of equal value, a technique now used on topographic and other kinds of maps. The 1886 Sanborn fire map includes as much as its business purpose requires, but nothing more. Triangulation maps, such as the 1744 map of France, show the network of points and lines, in this case colorfully framed within national boundaries. The 1989 earthquake map of the United States indicates the relative hazard by a contoured and colored surface, which also shows State boundaries.

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Activity I: On the Trail of Knowledge

Plot the earthquake epicenter data (figs. 1-2), on the base map of the North Atlantic ocean floor. Use different symbols or colors to characterize different values.

Time:

One 50-minute class period.

Materials:

- Earthquake data (fig. 2)
- Base map (fig. 1)
- Colored pens or pencils
- Ruler
- Scrap paper

Procedures:

1. Study the data to learn what information you have and to determine the range of values. This may be easiest to do by reorganizing the data in a new list or table. What are the lowest and highest magnitude values? Considering that the Richter scale of earthquake magnitude includes values from 0 to about 9, are mid-Atlantic earthquakes weak, medium, or strong?
2. Consider generalizing or grouping data to simplify the mapping. In other words, decide whether you need to map all

points to see the pattern in the data. Decide on symbols to use in plotting the data. Consider making a sample plot of some data points to test symbol size, color, etc.

3. Plot data points by latitude and longitude coordinates on the base map. Use a ruler as needed to help estimate locations between latitude and longitude lines. Choose a descriptive title, and make a scale and legend for the map.
4. Discuss the pattern revealed from mapping the data. Discuss the fact that two tsunami warning centers monitor the Pacific Ocean, but none monitors the Atlantic. What does this imply about magnitudes of earthquakes in the Pacific Ocean? (Note that Magellan commented on the appropriateness of the name of the Pacific Ocean.)

Extension:

Referring to the 1957 map of the ocean floor, and the quotation from Tharp's book, discuss this example of the process of scientific discovery.

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Earthquake data for 1990

Area from latitude 45°E to 45°W, longitude 0°E to 45°W.

Note: Magnitudes are measured on the Richter scale, in which every 1 point difference in magnitude represents a ten-fold difference in energy released by an earthquake.

From U.S. Geological Survey, National Earthquake Information Center's global hypocenter data base.



Fig. 1

Latitude	Longitude	Magnitude
21.77S	13.13W	4.7
32.14S	14.10W	4.4
30.73N	41.66W	4.6
27.13N	44.46W	4.7
33.65N	38.57W	4.8
6.44N	33.08W	5.1
33.74N	33.29W	4.8
13.50N	44.79W	4.3
7.37N	35.29W	5.7
17.20S	14.28W	4.6
0.54S	19.76W	4.6
14.64N	23.52W	4.2
8.47N	37.50W	4.7
3.62N	31.55W	4.7
1.21S	24.42W	5.1
38.37S	16.59W	5.0
26.71N	44.61W	4.5
0.94N	26.53W	4.9
23.63S	13.41W	4.6
28.45N	43.74W	5.3
44.75S	15.60W	4.8
4.52S	12.29W	5.1
0.07S	17.52W	5.8
44.62N	28.38W	4.8
4.37S	10.78W	4.8
0.54S	14.27W	4.8
39.91N	29.68W	4.3
37.10N	33.04W	4.4
7.14N	34.20W	4.8
0.96N	28.81W	5.2
35.43N	35.65W	6.0
17.70S	13.25W	5.1
9.53N	40.60W	4.9
13.97S	14.51W	5.0
41.31N	29.35W	4.5
27.72N	44.08W	4.9
0.26S	20.89W	4.8
24.89S	13.58W	4.6
43.65S	16.16W	5.3
0.06S	16.67W	5.0
7.62N	36.03W	5.0
35.21S	17.13W	4.9
8.28N	38.51W	4.0
43.73N	28.86W	5.7
2.16N	30.74W	4.7
0.98N	26.70W	4.5
42.55S	16.14W	5.4
21.03S	11.48W	4.9
1.13S	24.44W	4.9

Fig. 2

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Activity II: Maps With a “Spin”

In teams of three or four students, research and map the effects of a proposed airport three miles outside of town. Each team is to prepare a presentation based on a set of maps it makes. Teams will represent different points of view: town government, homeowner’s associations, business interests, developers, and State or county government. Teams will emphasize different information. All teams must use the same data, but each team can decide how to generalize the data and map the patterns they want to present.

Time:

Three evenings of homework for steps 1-3.

Two 50-minute classes for steps 4 and 5.

One 50-minute class for step 6.

Materials needed for each group:

- Base map of your locality (several copies)
- Geographic data from which to select map topics
- Local newspapers
- Calculators

- Graph paper
- Colored pencils or markers
- Stapler

Procedures:

1. As a class, collect basic geographic data from various sources: government, local libraries, student observations, businesses, and other organizations. For example, zoning and development regulations, weather records, locations of landfills and other waste sites, data on land use (residential, farming, commercial, governmental, recreational), boundaries of school districts, locations of fire departments and fire hydrants, water supplies, pipelines and powerlines, natural hazards (flood plains, landslides, earthquake risk zones), special scenic or historic sites, transportation features, wildlife refuges, and so on.
2. Sort the data by type: economic, climatic, demographic, and so on. Select data sets that are especially important for consideration in planning an airport.
3. Research local newspapers to identify interest groups active in local issues; briefly discuss

issues in class to clarify the point of view of each group. Evaluate maps in newspapers. Do they have “spin?” Break the class into the working groups.

4. Evaluate data and sketch a few test maps. Select only the data that support your point of view or need for information. Remember the importance of good choice of color, attractive lettering, and other aspects of map design in presenting information.
5. Prepare the final copies of materials for a town meeting. Make final copies of maps; be sure each map has a legend and cites sources of information. Be able to defend your choice of map type, symbols, colors, and generalization or groupings of data. Write notes or a paragraph to briefly explain what each map shows; these will be your speaking notes for the town meeting.
6. Have a class “town meeting” where the maps are presented and the issues are discussed. Allow each group 4 minutes to present its views, after which each group has 1 minute for rebuttal. The teacher or a student may act as moderator, keeping the meeting on time and on track.

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Glossary:

base map

compilation

context

distortion

generalization

groupings

isoline

map design

orientation

qualitative

quantitative

scale

bar scale

representative fraction scale

verbal scale

large scale

small scale

spatial data

thematic map

Additional activities:

Evaluate news coverage of a local development issue that uses maps. What kinds of maps are being used? Do the maps appear biased? How? Do different news organizations present different opinions, biases, or maps with different information? What seem to be the most effective ways to affect public opinion with maps?

Invite a geologist to class to talk about plate tectonics, perhaps looking at California earthquakes or the geologic story of the Hawaiian Islands, the Himalayas, or a nearby National Park.

Select two quotations, from the poster information, that seem especially pertinent to this activity sheet, and write an essay that discusses the ideas of both writers.

Recommended reading:

Monmonier, Mark. *How to Lie with Maps*. Chicago: University of Chicago Press, 1991.

Wood, Denis. *The Power of Maps*. London: The Guilford Press, 1992.